Integrated Nano-Technologies

little solutions for big problems

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Agenda

1. The Challenge
2. DNA
3. Applications
4. What’s next

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The Challenge

Gain the ability to accurately & reliably facilitate economically viable, bottom-up control and self-assembly of complex nano-structures

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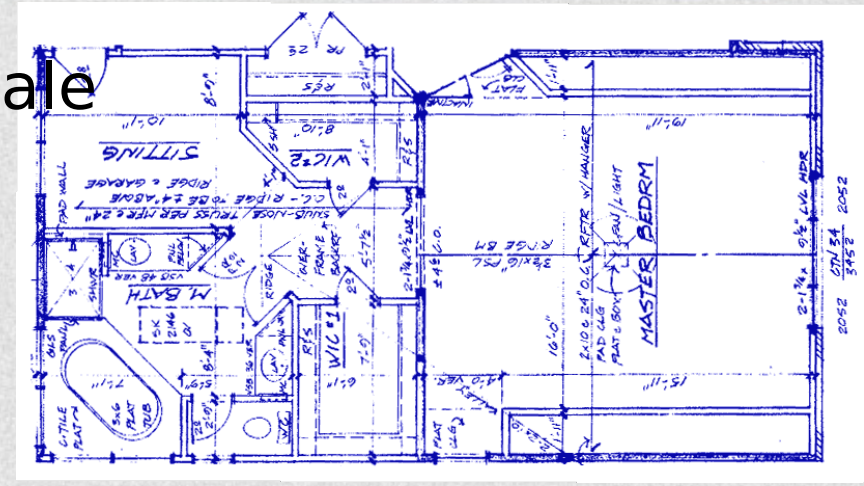
The Ideal Set of Tools

To effectively build on any scale you must have:

- Information
- Tools



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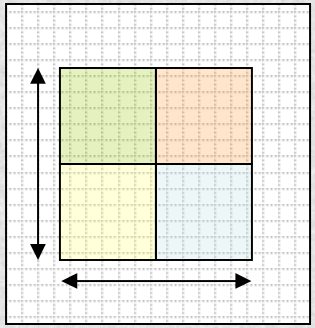
Top-Down

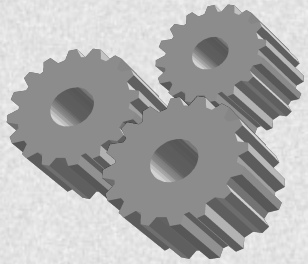
Materials

Plus



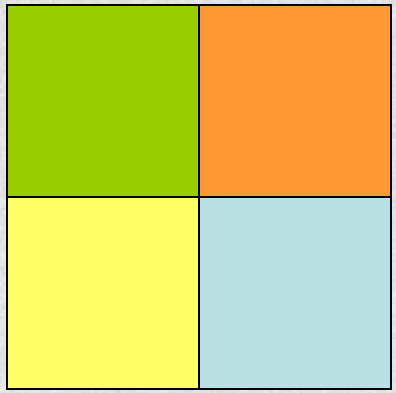
Plan/Information

Plus



Tools

Creates



Product

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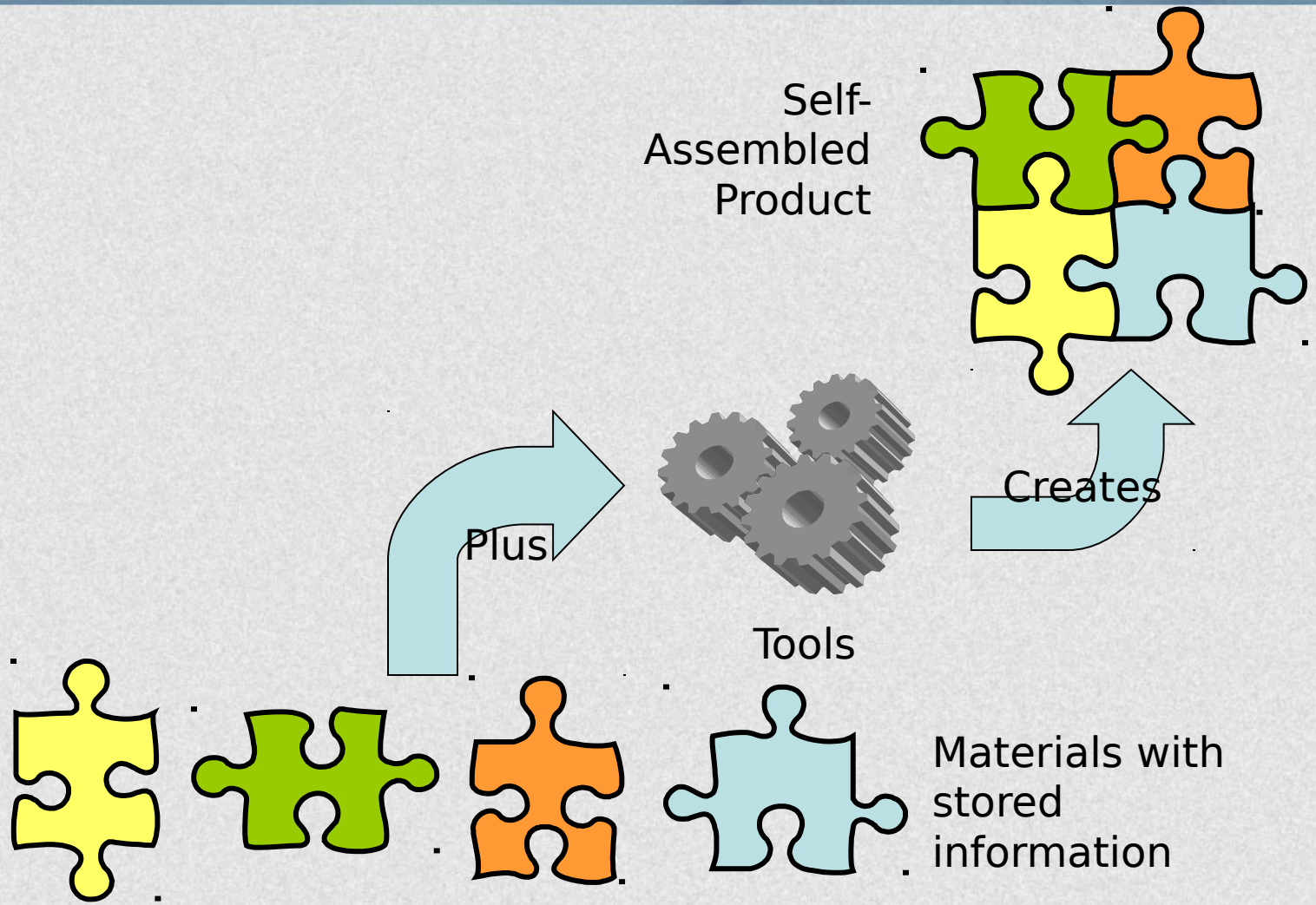
Bottom-Up



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The Ideal Nano Material

To effectively build complex structures, from the bottom-up, on the nano-scale, you must have materials that:

- Can store information
- Can be manipulated through:
  - Cutting
  - Splicing
  - Copying
  - Duplicating

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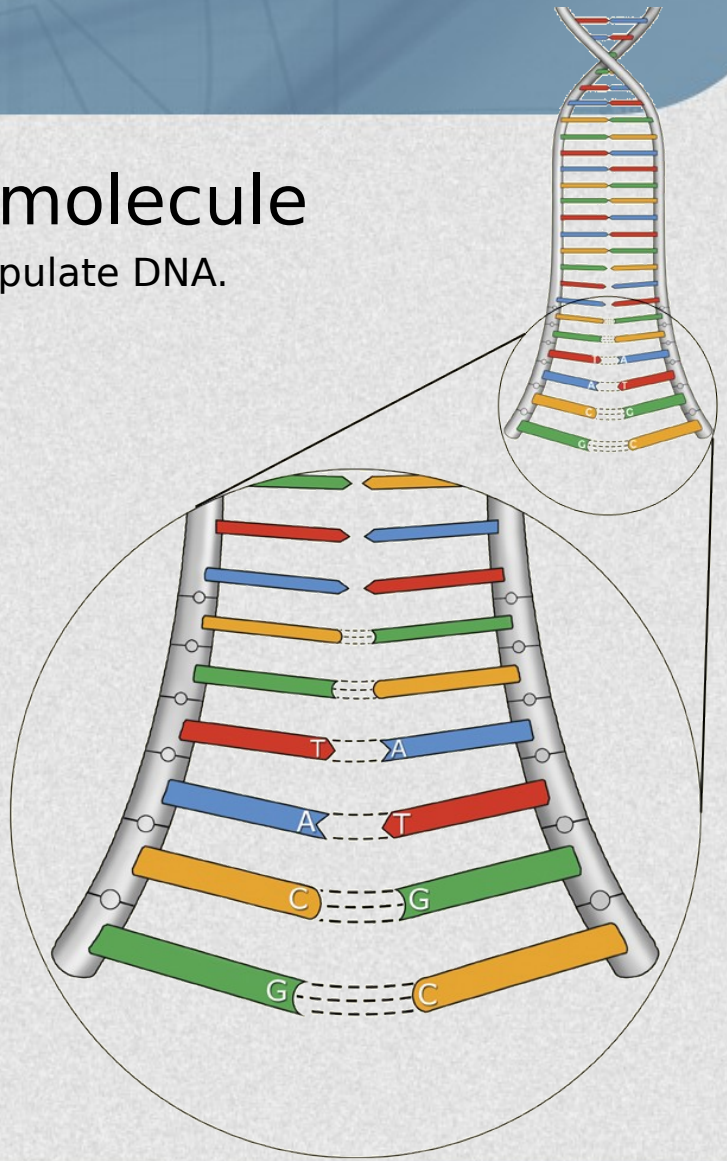
DNA & Information

DNA is an information storage molecule

Nature has provided a comprehensive tool set to manipulate DNA.



- Cut/Edit
- Splice/Join
- Copy
- Duplicate

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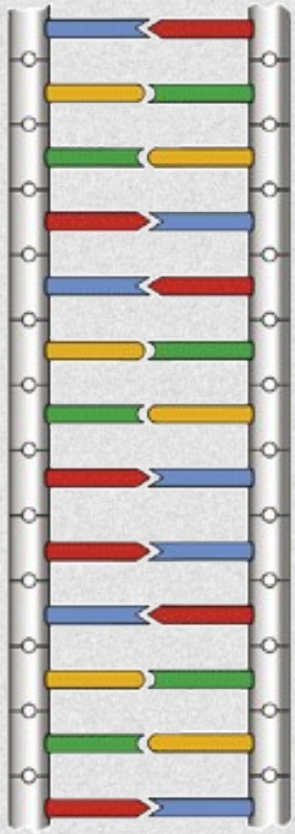
Building with DNA

DNA can be used as a substrate

Materials can be added to change:

- Electrical Properties
- Specific Dimensions
- Rigidity



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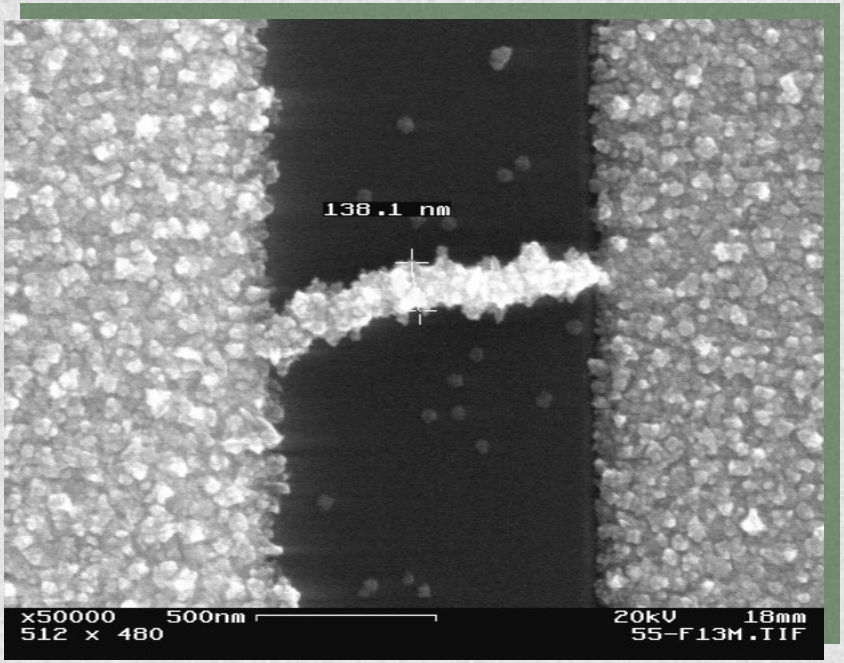
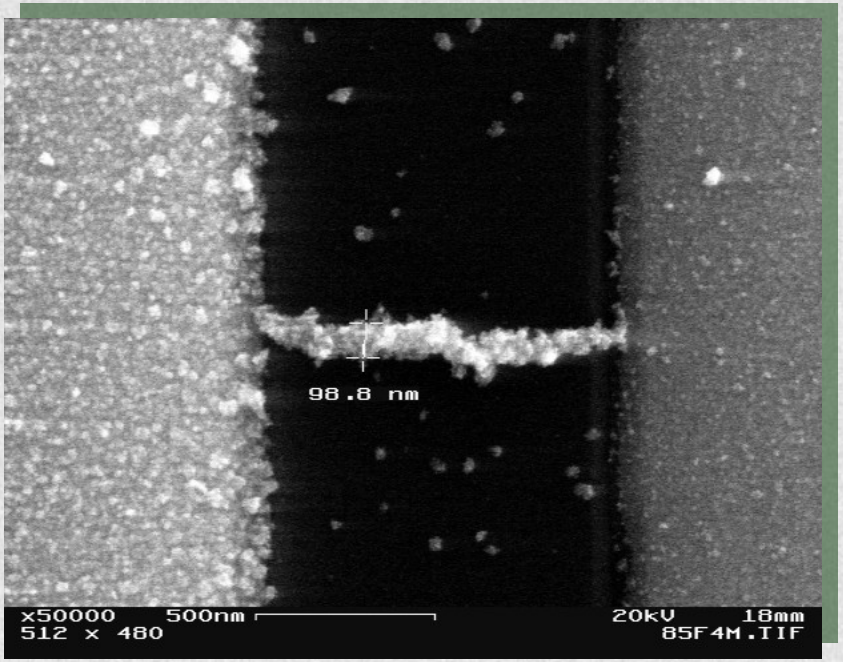
Coated DNA Wires





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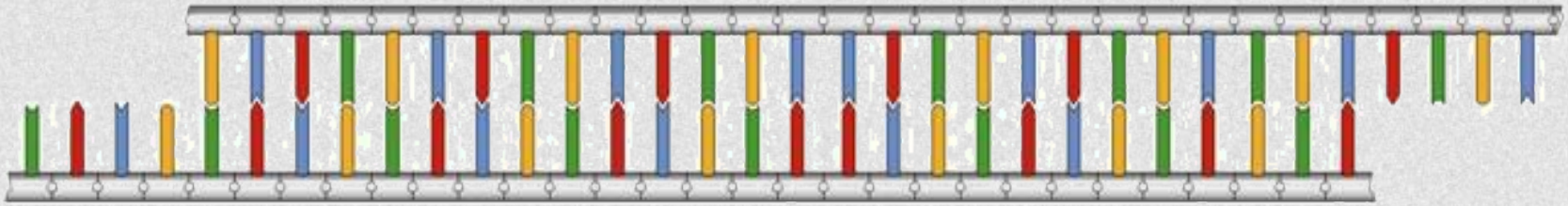
DNA Lithography

Procedure for making nano-scale electronic components



Specifically synthesized DNA strand with tailed ends

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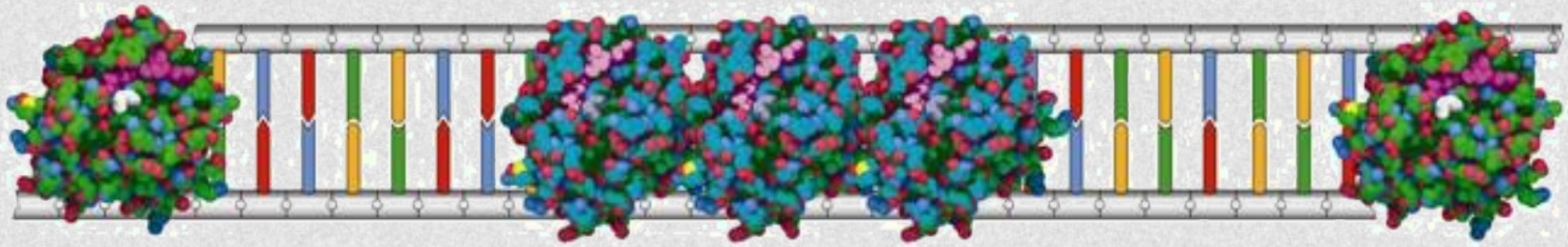
DNA Lithography

Procedure for making nano-scale electronic components



Proteins applied to the ends, different proteins applied to the center

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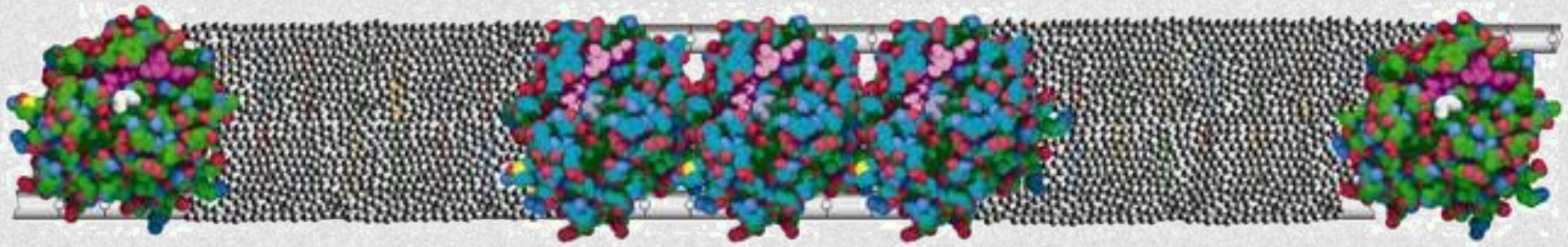
DNA Lithography

Procedure for making nano-scale electronic components



Unblocked section of DNA, coated

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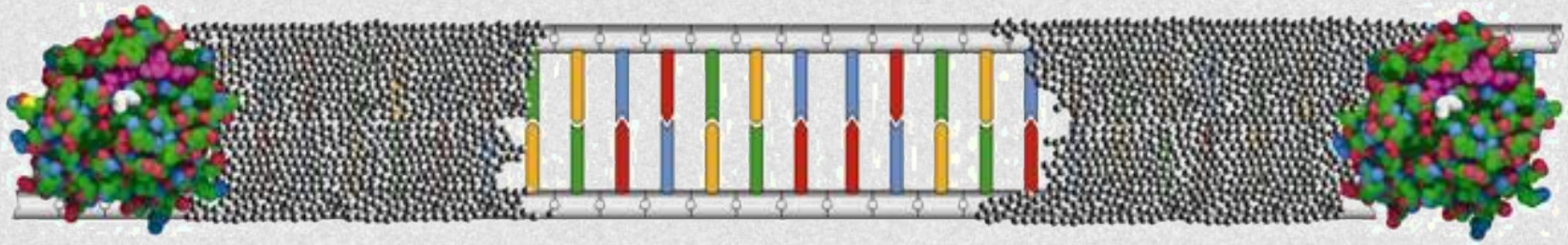
DNA Lithography

Procedure for making nano-scale electronic components



Center proteins removed

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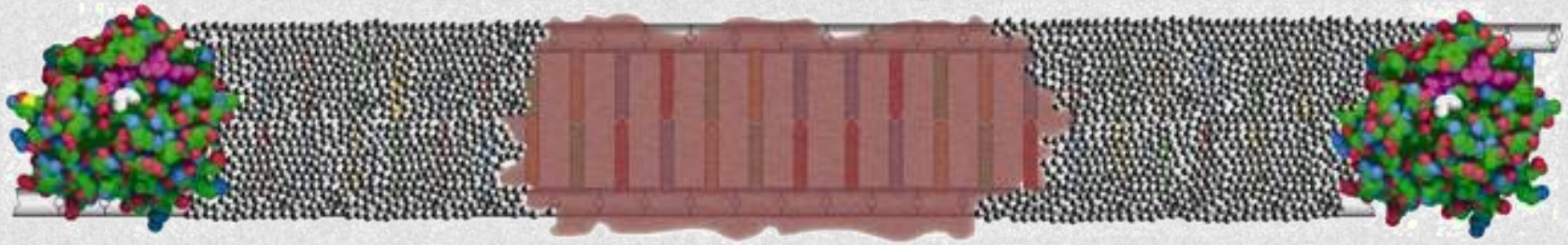
DNA Lithography

Procedure for making nano-scale electronic components



Unblocked section of DNA, coated

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DNA Lithography

Procedure for making nano-scale electronic components

End blocking proteins removed, nano-scale component created

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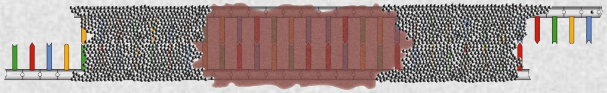
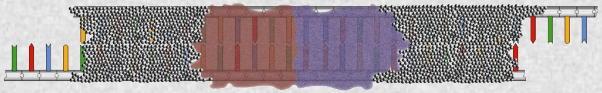
Complex Devices

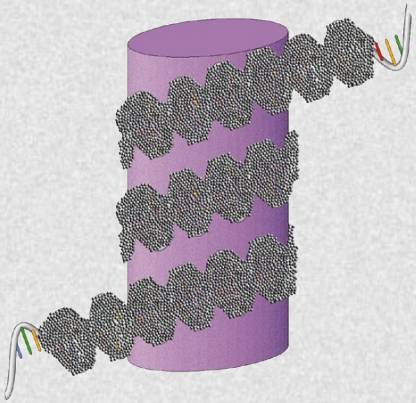
Using DNA Lithography, complex structures can be created



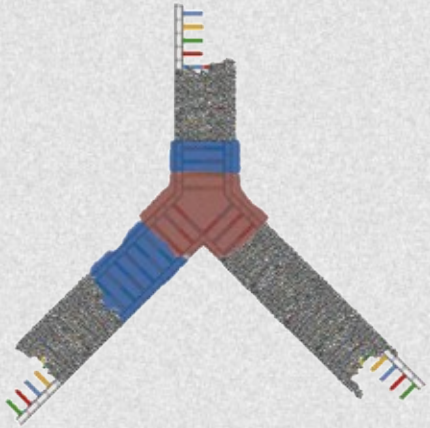
DNA Resistor



DNA Diode



DNA Inductor



DNA Transistor

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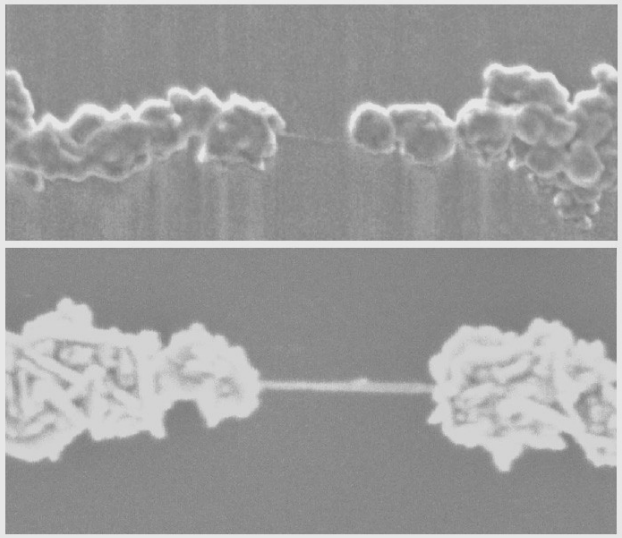
Technion Research

- 2003 – Journal Science
- Keren et al, publish the creation of a DNA-Templated Field Effect Transistor (FET)



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APPLICATIONS

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Applications

INT's technology can be applied to

- BioSensors - Public Safety & Military
- Taggants - Forensic & anti countefeiting
- Catalysts – Industrial, automotive & hydrogen fuel cells
- Structures - Stronger, lighter materials
- Healthcare - Diagnostic devices & drug delivery systems
- Nano-Electronics – RFID Tags, smart materials

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The Detection Challenge

The inability to detect and rapidly identify biowarfare agents and emerging diseases poses significant challenges.

System must be:

- Portable
- Accurate
- Rapid
- Low cost
- Easy to use

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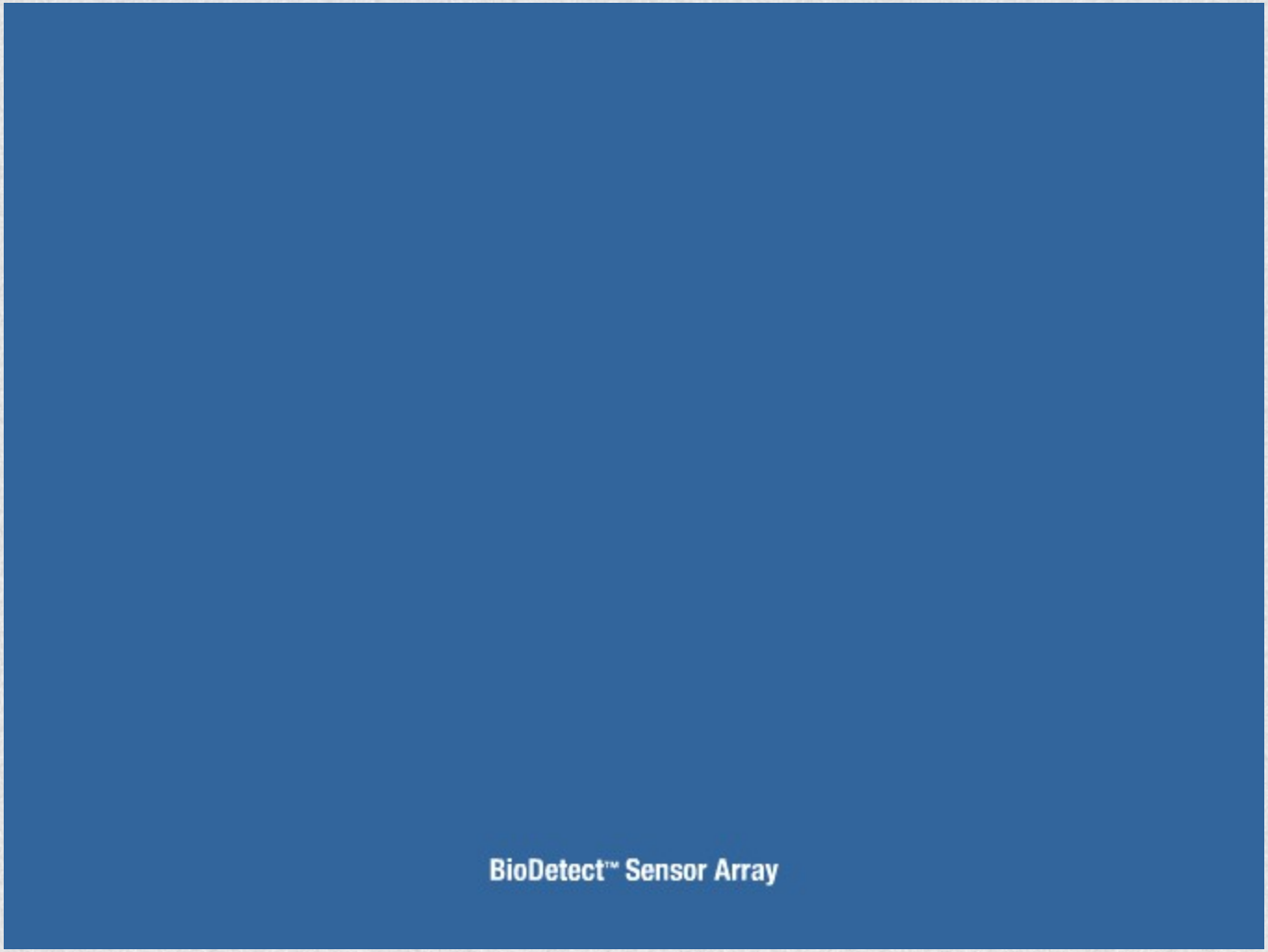
How BioDetect Works



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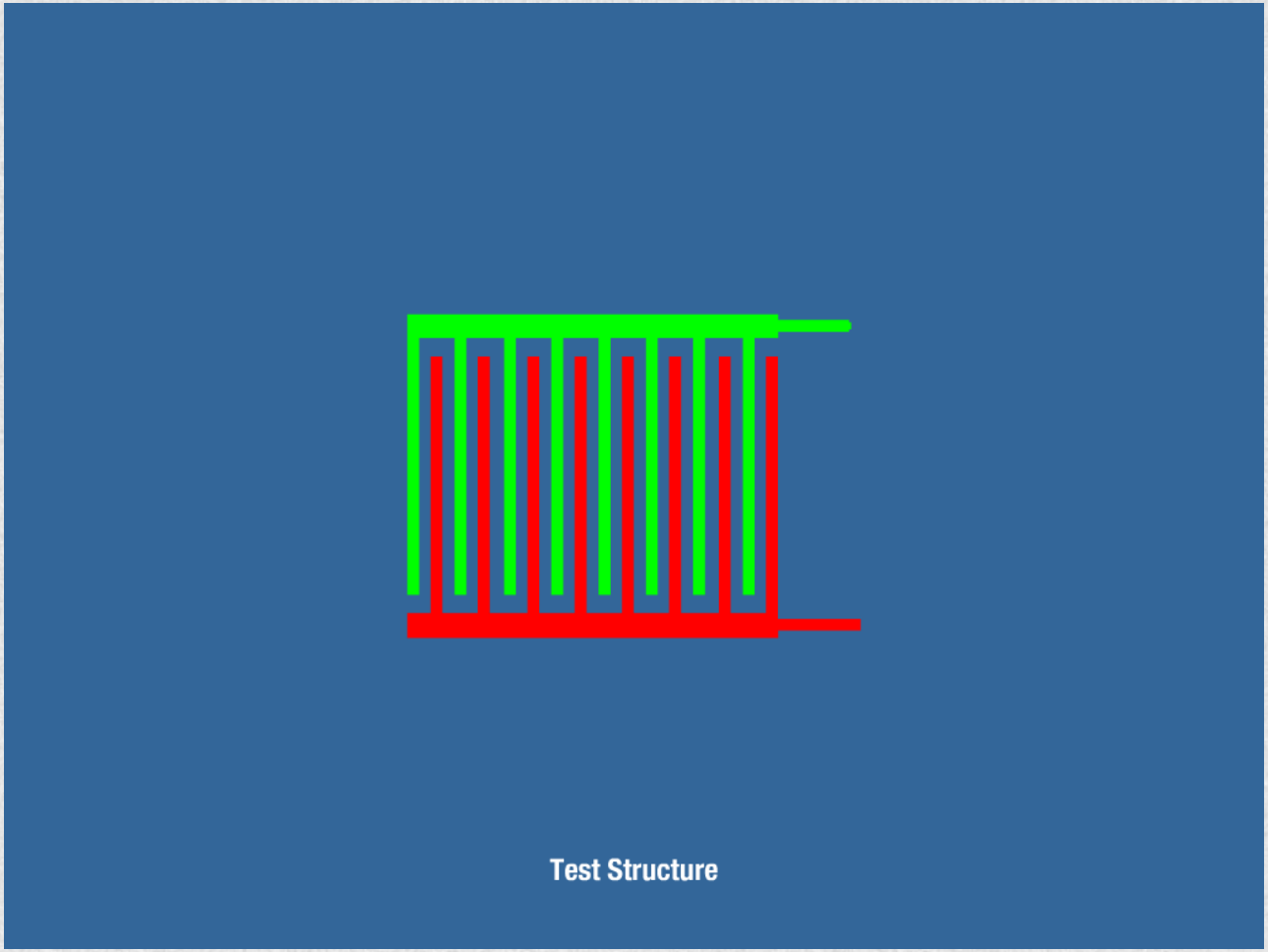
INT's BioDetect



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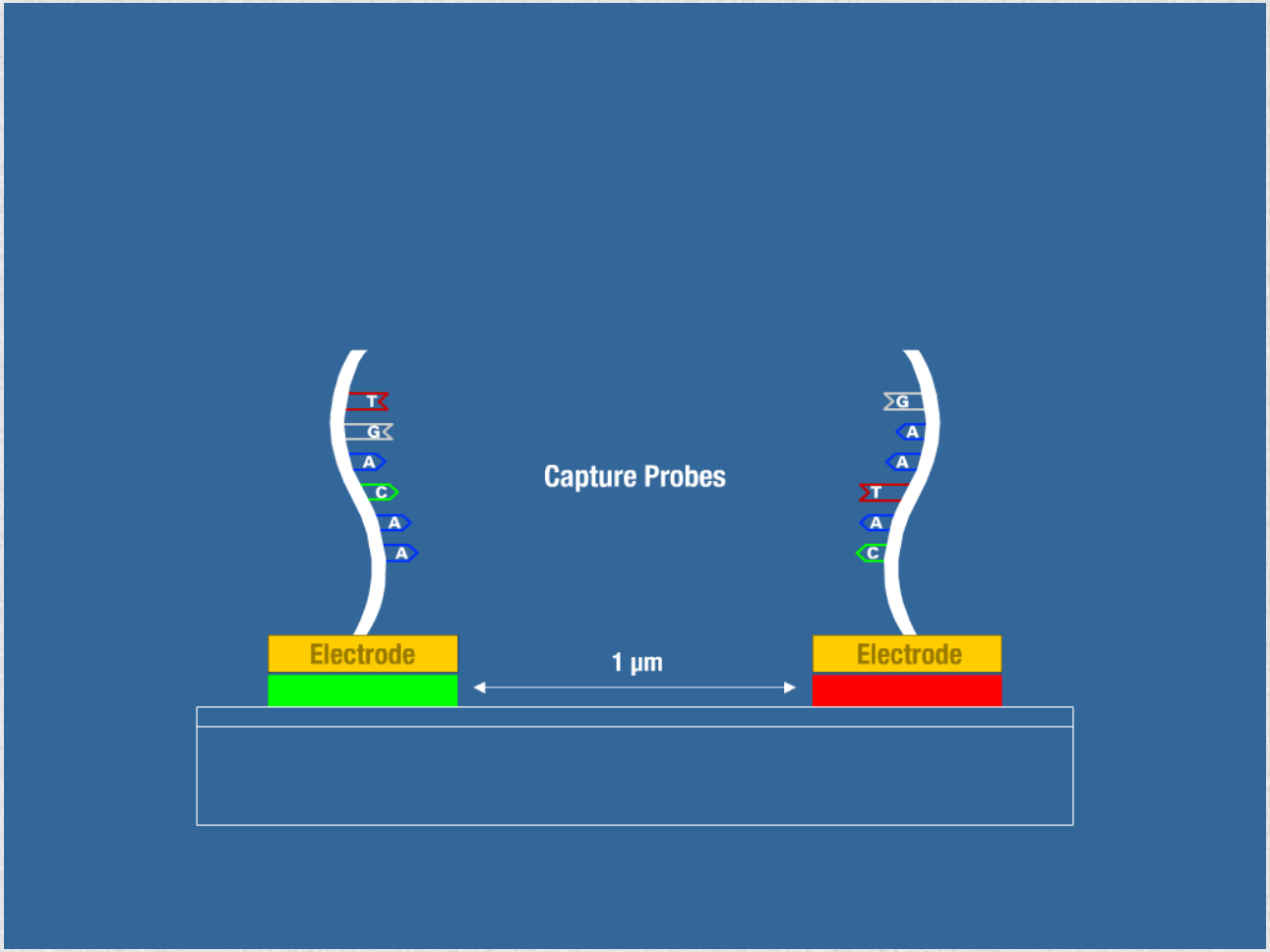
INT's BioDetect



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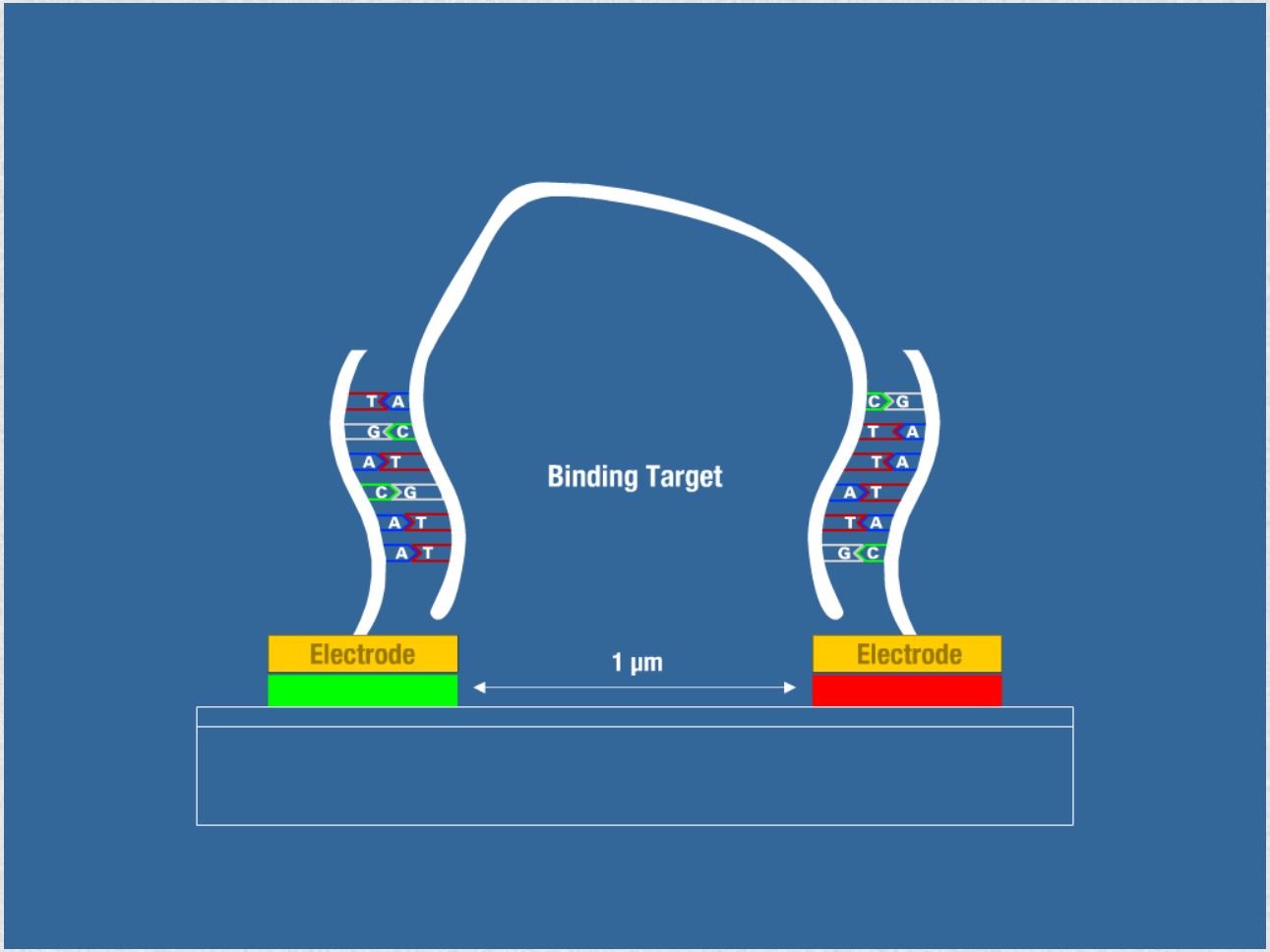
INT's BioDetect



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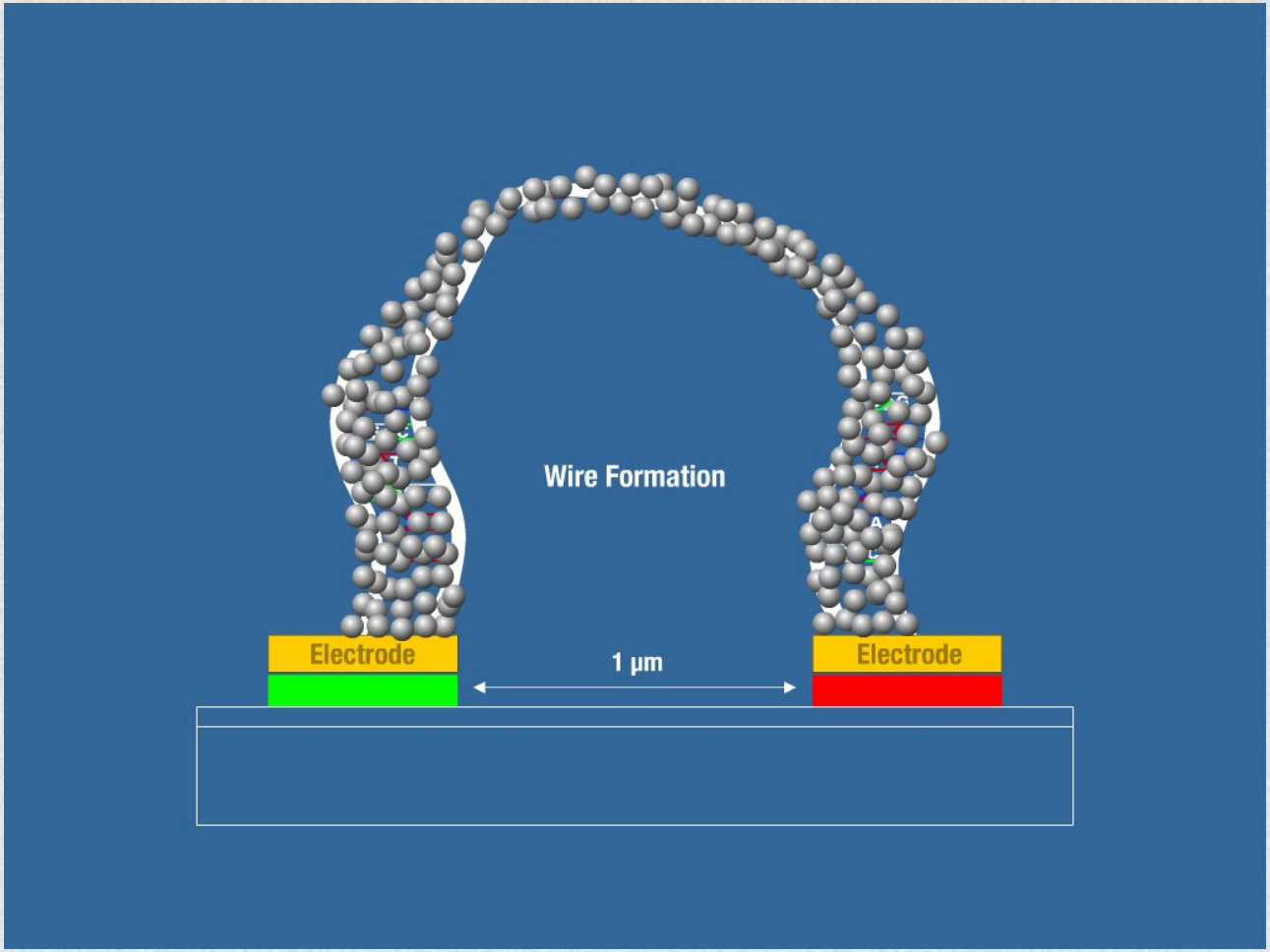
INT's BioDetect



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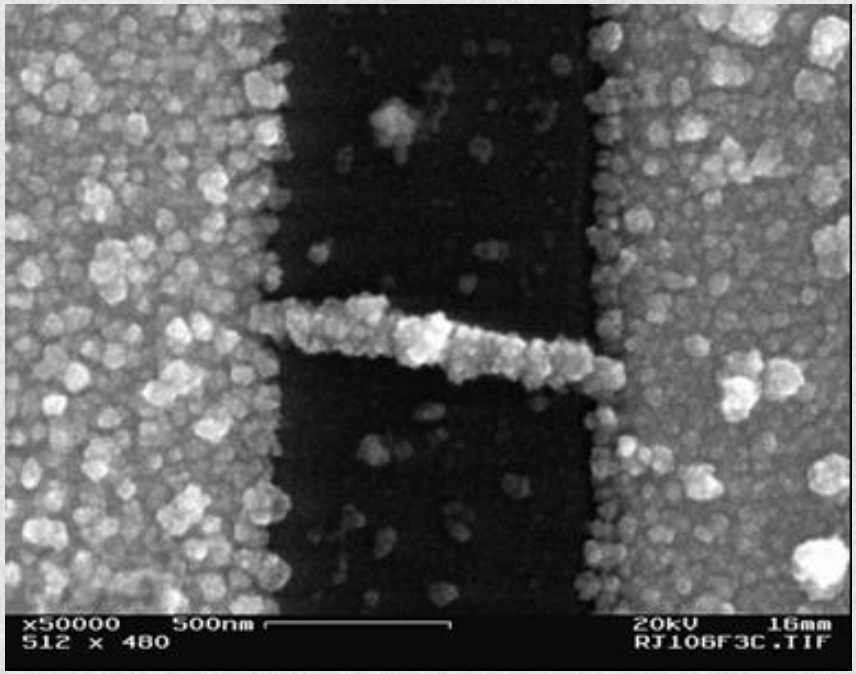
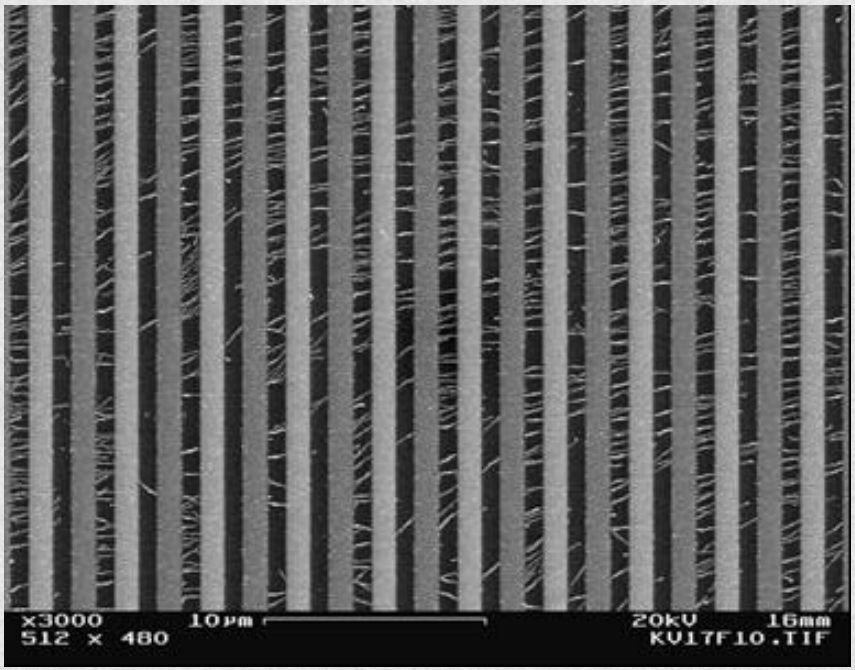
BioDetect Images



Single Bridge



Thousands of Bridges

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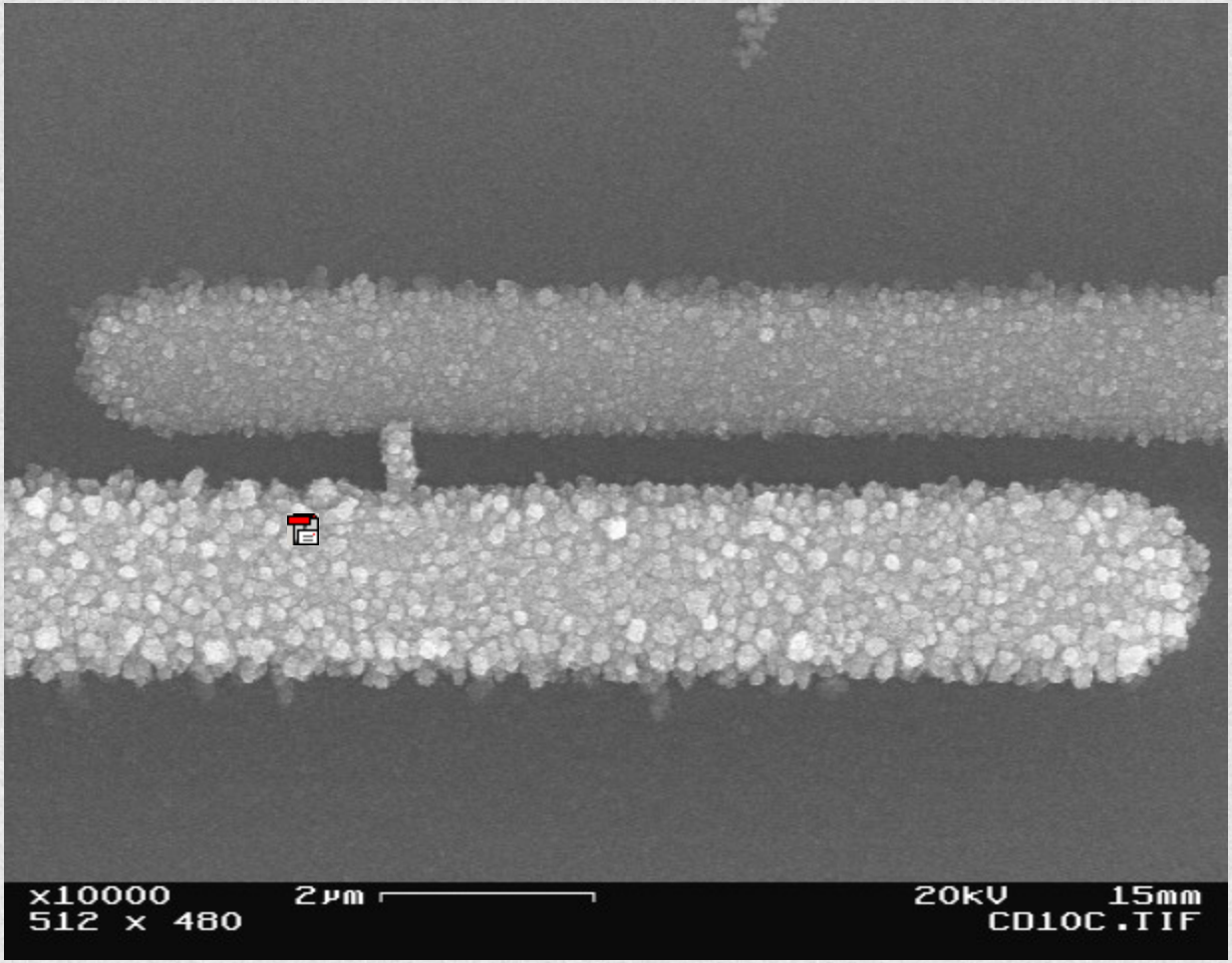
Single Bridge Detection

Probe Only Resistance:

2000 kΩ

Single Bridge Resistance:

1.8 kΩ



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Prototype System Under Development

- Prototype *B. anthracis* test developed.
- Demonstrated Proof of Concept with ECBC Biosensors Group Fall 2004. Written report pending.
- System demonstration expected Jan ’05 using a Generation I chip design, prototype micro-fluidics card, and prototype instrument.

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Projected Accuracy & Sensitivity

	GEN I	GEN II
Tests	14/64	250
Detection **# of spores**	100	<10
Time **minutes**	25	<5

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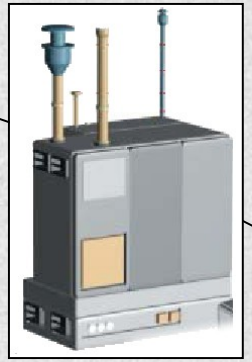
BioDetect Military Applications

Mobile Systems



Perimeter Systems

UAVs

Handheld Systems

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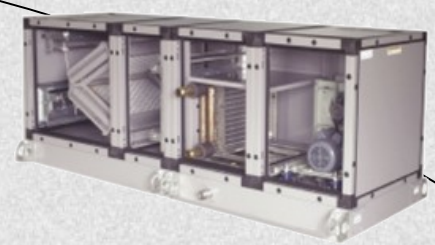
BioDetect Public Safety Applications

First Responders



Air Handlers/HVAC

Food/Environmental Safety

Clinical Diagnostics

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WHAT'S NEXT?

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What’s next?

- Radio Frequency Tags
- Drug Delivery Systems
- Arterial Plaque Removal Devices
- Enhanced Catalytic Converters
- Enhanced Fuel Cells
- Anti-Counterfeit & Taggant Systems

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